This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

---

1. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{1456}{13}}$$

The solution is Irrational, which is option B.

A. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

B. Irrational

* This is the correct option!

C. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{112}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

2. Simplify the expression below and choose the interval the simplification is contained within.

$$20 - 3^2 + 8 \div 5 * 10 \div 1$$

The solution is 27.000, which is option C.

A. $[11.16, 17.16]$

11.160, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[44, 55]$

45.000, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

C. $[26, 29]$

* 27.000, this is the correct option

D. $[28.16, 35.16]$

29.160, which corresponds to two Order of Operations errors.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-9 - 5i)(-8 - 10i)$$

The solution is $22 + 130i$, which is option E.

A. $a \in [114, 125]$ and $b \in [50, 53]$

$122 + 50i$, which corresponds to adding a minus sign in the first term.

B. $a \in [114, 125]$ and $b \in [-51, -49]$

$122 - 50i$, which corresponds to adding a minus sign in the second term.

C. $a \in [17, 23]$ and $b \in [-132, -126]$

$22 - 130i$, which corresponds to adding a minus sign in both terms.

D. $a \in [70, 74]$ and $b \in [50, 53]$

$72 + 50i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

E. $a \in [17, 23]$ and $b \in [129, 132]$

* $22 + 130i$, which is the correct option.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(4 + 7i)(-9 + 6i)$$

The solution is $-78 - 39i$, which is option C.

A. $a \in [-37, -30]$ and $b \in [39.9, 42.2]$

$-36 + 42i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

B. $a \in [4, 7]$ and $b \in [-89.3, -86.1]$

$6 - 87i$, which corresponds to adding a minus sign in the second term.

C. $a \in [-83, -74]$ and $b \in [-40.8, -38.1]$

* $-78 - 39i$, which is the correct option.

D. $a \in [-83, -74]$ and $b \in [38.8, 41.8]$

$-78 + 39i$, which corresponds to adding a minus sign in both terms.

E. $a \in [4, 7]$ and $b \in [86.5, 89.6]$

$6 + 87i$, which corresponds to adding a minus sign in the first term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

5. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{1040}{0}} + \sqrt{99}i$$

The solution is Not a Complex Number, which is option D.

A. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

B. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

C. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

D. Not a Complex Number

* This is the correct option!

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

6. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{0}{625}} + \sqrt{8}i$$

The solution is Pure Imaginary, which is option E.

A. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

B. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

C. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

E. Pure Imaginary

* This is the correct option!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

7. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{5}{0}}$$

The solution is Not a Real number, which is option E.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

C. Irrational

These cannot be written as a fraction of Integers.

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Not a Real number

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{\frac{5}{0}}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

8. Simplify the expression below and choose the interval the simplification is contained within.

$$4 - 6 \div 19 * 5 - (20 * 13)$$

The solution is -257.579, which is option D.

A. $[-257.17, -255.04]$

-256.063, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[-228.8, -228.39]$

-228.526, which corresponds to not distributing a negative correctly.

C. $[263.26, 264.85]$

263.937, which corresponds to not distributing addition and subtraction correctly.

D. $[-258.68, -256.21]$

* -257.579, which is the correct option.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{9 + 55i}{-7 + 6i}$$

The solution is $3.14 - 5.16i$, which is option A.

A. $a \in [3, 5]$ and $b \in [-6, -5]$

* $3.14 - 5.16i$, which is the correct option.

B. $a \in [3, 5]$ and $b \in [-440, -438]$

$3.14 - 439.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-5, -3.5]$ and $b \in [-4, -3]$

$-4.62 - 3.89i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [-2, 0.5]$ and $b \in [8, 10]$

$-1.29 + 9.17i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [266.5, 269]$ and $b \in [-6, -5]$

$267.00 - 5.16i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

10. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-36 - 22i}{5 + 6i}$$

The solution is $-5.11 + 1.74i$, which is option C.

A. $a \in [-312.5, -311.5]$ and $b \in [0, 2.5]$

$-312.00 + 1.74i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [-5.5, -3.5]$ and $b \in [105, 106.5]$

$-5.11 + 106.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [-5.5, -3.5]$ and $b \in [0, 2.5]$

* $-5.11 + 1.74i$, which is the correct option.

D. $a \in [-8.5, -6.5]$ and $b \in [-5, -2.5]$

$-7.20 - 3.67i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-2.5, 0]$ and $b \in [-6, -4.5]$

$-0.79 - 5.34i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.
